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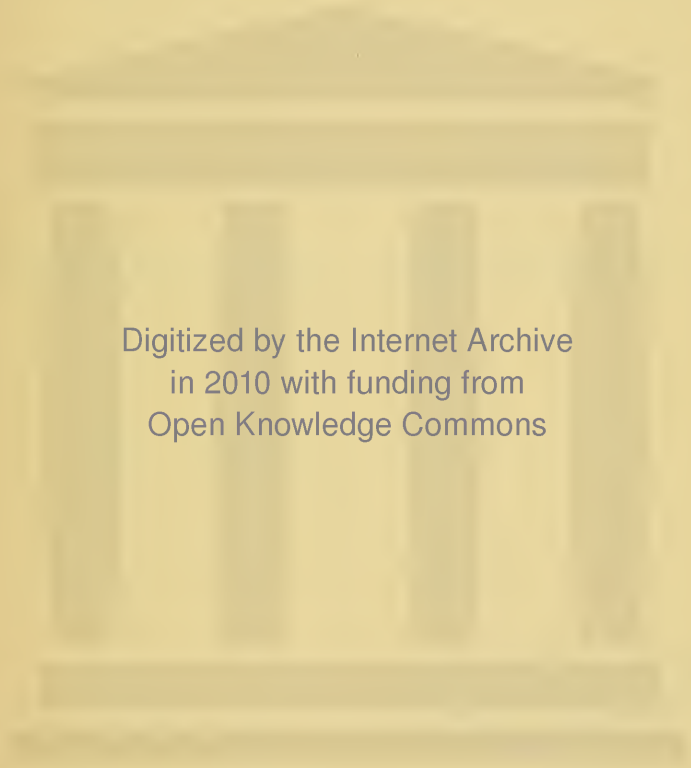

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Crawford, J. B.

Dr. John G. Curtis
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WOUNDS OF THE BRAIN

DR. JOHN B. CRAWFORD

COLUMBIA UNIVERSITY
DEPARTMENT OF PHYSIOLOGY
COLLEGE OF PHYSICIANS AND SURGEONS
437 WEST FIFTY-NINTH STREET
NEW YORK

WOUNDS OF THE BRAIN

AN ESSAY

READ BY APPOINTMENT BEFORE THE

LUZERNE COUNTY MEDICAL SOCIETY

AT WILKES-BARRE, JAN'Y 14, 1885

BY

DR. J. B. CRAWFORD

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WOUNDS OF THE BRAIN.

There are two classes of diseases, and likewise of injuries, the treatment of which has not yet been very generally agreed upon, and which seems likely to long remain unsettled. I refer to those widely differing conditions in which the disease or the injury is so slight that the unaided efforts of nature usually suffice to effect a restoration to health, or a complete repair of the injury; and to those malignant diseases and grave injuries in which the best directed therapeutic or surgical skill appears to exert but little power in averting a fatal termination. Whatever is done for the one class of cases *seems* to succeed; and consequently an endless variety of supposed remedies and of surgical procedures, each asserting superiority over its rivals, claims our adoption; while, on the other hand, whatever means we apply or whatever measures we adopt, are usually doomed to failure, and acquire only disrepute.

The subject of our discussion to-day—wounds of the brain—is mainly included in the latter class. They are always of grave import; yet while none are so trivial as to be destitute of danger, or to be disregarded in treatment, few, which are not immediately fatal, are so severe as to preclude the possibility of recovery. It becomes important, therefore, for the surgeon to determine how to direct his efforts, in treating this class of injuries, so as to secure the largest measure of that limited success that is attainable.

That great central mass of nervous matter called the brain or encephalon, is confined within the bony cavity of

the cranium, which it closely fills. It is surrounded by a strong fibrous envelope which closely invests its exterior and applies itself to all the intricacies of its conformation. It consists, in the main, of a central mass of white medullary matter surrounded by an envelope of gray or cortical substance. Originating in the peripheral or gray matter, innumerable nerve-fibres connect the corresponding portions of the hemispheres, associate the different organs, and converge from every portion of the periphery of the cerebrum to penetrate the ganglia at its base, and pass into its closely associated organ, the spinal cord. The blood supply of this organ is derived from the internal carotid and vertebral arteries. These several vessels, uniting, form an important vascular plexus at the cerebral base, and send their diminishing branches towards its periphery. It will thus be seen that the more highly vitalized parts of this organ are located in its central basilar portions; that the nerve-fibres, upon the integrity of which the continued vitality and functional activity of all other portions of the system depends, are concentrated in this portion of the brain; and that the vascular supply of the entire organ is concentrated in the same locality. If we trace either the nerve fibres or the arteries from this central portion, we find them diminishing in size and in relative proportion to their surrounding tissues, as they approach the external portions of the hemispheres. These anatomical characters of the brain may help us to understand why it is that so widely different results follow apparently similar injuries of the brain; and why it is that recovery will at one time follow extensive destruction of the cerebral mass, while the slightest injury of another portion is instantaneously fatal.

It may be well, too, for purposes of diagnosis, to note some physiological facts in relation to this organ. The hemispheres are so slightly associated with the functions of physical life, that extensive destruction or removal of a

considerable portion of their substance may take place without necessitating a fatal result. They seem to be especially connected with the manifestation of conscious intelligence; and while their complete integrity is essential to the highest manifestation of intellectual power, extensive portions of their substance may suffer morbid alteration, mechanical injury, or destruction of substance without necessitating a fatal result, or an entire abolition of mental power. They combine the mechanism of conscious sensations and voluntary movements. The recent improvements in our knowledge of cerebral physiology relate chiefly to the localization of these powers. They demonstrate that certain portions of the cerebral cortex are connected with the phenomena of motion, others with sensation, while still others are associated with nervous phenomena of different kinds. "The cerebral hemispheres," says Dalton, "do not act indiscriminately, as a whole; but the convolutions of particular regions have a structure and properties differing from those elsewhere." The knowledge thus far gained relates chiefly to three different points, to wit: centres of sensation, centres of motion, and centres of language. But it is chiefly with the centres of motion that the diagnosis of cerebral injuries is mainly concerned. These portions of the cerebral substances lie around the fissure of Rolando, and embrace the anterior and posterior central convolutions. This portion of the human brain, as well as the corresponding portion of the brain of animals, in which like phenomena have been observed, is characterized by the presence of giant pyramidal cells, which are only found in those portions of the cerebral substance, and constitute a structure that is found only within the limits of the motor area. It has been further ascertained that the power of voluntary motion of the face and tongue originate in the lower third of this region; that motions of the arm have their origin in the middle third, while motions of the lower

extremity originate in the upper third of this motor area. Injuries of other portions of the brain may often be inferred by certain nervous phenomena; but the localization of most other functions of the cerebral hemispheres has not yet been ascertained with such accuracy as to make it a reliable and infallible basis of diagnostic opinion or of surgical procedure.

The location of the human brain is such as to make it especially liable to a great number and variety of traumatic injuries. Forming the highest portion of an erect body, exceedingly liable to be overturned, it usually receives from such an accident the severest shock that is borne by any portion of the system. It is the objective point of fists, bludgeons and missiles in all personal encounters; and it seems to be the recipient of an undue proportion of the injuries resulting from accidental causes. In war it encounters a larger proportion of destructive missiles than come in contact with any other portion of the body of corresponding size. The delicacy of the structure of this organ, and the want of firmness or tenacity of its tissues renders it liable to destructive lesions from a degree of violence that would do little harm to other portions of the system. A blow from the fist upon any portion of the cranium leaving, perhaps, no external mark of violence, may cause a fatal lesion of some portion of the brain; or the resulting concussion may, without appreciable lesion, so shock and paralyze the nervous centres as to endanger, or perhaps to destroy life.* Or a hæmorrhage within the cranium may be produced by similar apparently slight causes, and by its pressure involve an equally dangerous result.

But it is the more violent forms of injury of the brain and its associated organs that I propose at present to con-

*See note i.

sider. These consist, for the greater part, of fractures of the skull and consequent and associated injuries of the cerebral mass and its enveloping membranes. Fractures of the cranial bones, unless associated with lesion of the brain, do not come within the purview of our present discussion. While fractures of the skull may and often do, occur without an involvement of the brain, the latter organ is often injured by displaced fragments of the cranial bones, pressing upon the surrounding membranes, or penetrating its substance. Sharp or pointed instruments sometimes penetrate it more or less deeply. Missiles, like bullets, fragments of shells, arrows, fragments of iron impelled by an exploding boiler, etc., produce an endless variety of injuries of this organ. These may penetrate its substance to any depth, may pass entirely through, or lodge within its substance, and may carry with them fragments of bone, portions of clothing or other material, to be deposited along the line which they traverse through this organ.

When the recipient of one of these injuries survives long enough to allow a surgeon to be called to his assistance, the doctor usually feels a greater degree of embarrassment and uncertainty in regard to the measures to be adopted for the promotion of his patient's recovery, as well as to the probable result of either the injury or its treatment, than he is accustomed to experience in the management of any other class of injuries. His patient is probably unconscious, and no interrogation of him can elicit any information that can serve to guide his treatment. A slight external wound is, perhaps, the only visible injury; yet it is evident that beneath the cranium, hidden from view, inaccessible to the touch, and secluded from all his powers of observation, there exists a serious lesion of the brain. In regard to its precise nature, its exact location or extent he feels altogether uncertain; and he is likely to feel a corresponding uncertainty as to the most appropriate and efficient

measures to be adopted. If he turns to the standard authors in surgical literature for guidance, he finds but scanty aid — for the precepts there laid down for his guidance in such cases, are diverse and contradictory. If he relies upon his own experience and judgment, he is likely to find that what he has seen in other apparently similar cases is by no means repeated in the present one. His greatest embarrassment comes from the impossibility of knowing, with precision the exact nature or extent of the injury. If he attempts to explore the wounded organ and to ascertain the location and extent of the injury, he is not only liable but likely to complicate the existing injury. If he pursues a "*Masterly inactivity*" his patient may die for the want of some simple procedure, like the removal of a spiculum of bone or other material that has been carried into the substance of the brain, and which is easily accessible. What then can he do?—Or what should he do? How shall he decide the uncertain problem and execute the serious duty that confronts him? It would seem that the course of duty must lay somewhere between officious interference on the one hand and a blind and passive trust in the recuperative powers of nature on the other. There are undoubtedly cases in which the most radical and heroic procedures are not only justifiable but imperative. There are others in which any active interference can only do positive harm, and greatly diminish any existing chances of recovery. A wise discretion, therefore, will incline him to set aside all rigid rules of procedure; to discard so called "authorities," and to judge for himself what are the indications for treatment in the particular case that he has in hand. He should consider that there are widely differing degrees of susceptibility in different portions of the brain—that the anterior and middle lobes of the brain are more tolerant of traumatic lesion than other portions of the organ,* and

*See note ii.

that while they are more liable to suffer from the effects of severe concussion, and in their basilar parts are especially liable to laceration from the latter cause—they more frequently recover from destructive injuries, like penetration, laceration, and loss of substance, than do any other portions of the cerebral mass. He should remember too that all lesions of the brain become more serious as they approach the central and basilar portions, and that the difficulties and dangers of surgical interference in these localities are correspondingly enhanced. He should in no case act with undue haste. The case may at first seem much worse than it really is. The brain may be so shocked, aside from any actual lesions, that its functions are, for the time, almost suspended—just as a bar of magnetic iron loses its magnetic power by receiving a violent blow. He should, therefore, unless some urgent necessity for immediate interference exists—such as a dangerous compression or irritation from a depressed or detached fragment of skull or other substance, or an exhausting hæmorrhage—give sufficient time for the system to rally, so far as it may, from the more transient effects of the injury, before proceeding to any operative measures.

In whatever he undertakes to do, he should be guided by the conditions and symptoms presented. There may be slight external marks of injury; and yet there may be an extensive fracture of the inner table of the skull, producing compression, laceration, or hæmorrhage of the brain. If the signs of these conditions, or any of them, are present and persistent, an exploration of the injured part, and elevation of the depressed bone,—and if need be, —the removal of a superficial clot, and measures for the arrest of hæmorrhage should be undertaken. This may involve the use of the trephine,* and it should be boldly resorted to when the indications for its use are apparent. This class of cases is usually very perplexing to the sur-

*See note iii.

geon; for the slight external injury serves as but a doubtful guide in locating the serious injury which he is seeking to relieve. The localization of cerebral functions, as ascertained by recent physiological investigations, will, in some instances, enable him to determine the seat of the injury.* In other cases there may be a more or less extensive external wound, with manifest depression; and yet the case may present no symptoms that would justify the measures necessary for an elevation of the bone. These cases should be sedulously watched. Symptoms *may be developed* that demand an application of the trephine. Whatever symptoms appear, or whatever complications arise, should be met and combatted, as they become apparent, by an application of the general principles of surgery — otherwise they should be skillfully let alone. In still other cases, an extensively shattered skull, and a like extensively wounded brain, may be presented. The patient may be conscious or comatose, sensitive, anæsthetic or paralytic, according to the location and extent of the injury. A prompt removal of depressed and displaced fragments of bone and other foreign or vulnerating materials, when they can be readily found will, in such cases, be the most judicious course. If the patient survives the direct effects of one of these injuries, there are various complications that may arise in its subsequent history. Inflammation of the brain, and of its membranes, with their resulting sequences, are to be, if possible, averted; or met and combatted by prompt and vigorous measures if they appear. The patient should in all cases be kept quiet, and if possible in a darkened room. The head should be elevated and kept cool. The cerebral circulation should be moderated by bromides, and general antiphlogistic measures adopted. If symptoms of cerebral or meningeal inflammation arise, no time should be lost, and no reasonable effort spared, in combatting them. The

* See note iv.

head should be shaved, and ice applied to the scalp. Active purgation, counter-irritants to the extremities, and the local abstraction of blood, should be resorted to; even the "lost art" of bleeding might here well be revived, and again put into requisition. Should bromides prove inefficient in controlling nervous excitement, opium should be substituted for or combined with it. Every measure that can tend to diminish cephalic irritation should be promptly and energetically employed. As the inflammatory process, unless limited or controlled, must certainly be fatal, its appearance should always be met by early, prompt and energetic treatment. Should the patient survive the acute inflammatory stage, there still remain the dangers of diffused suppuration; of abscess; of paralysis; of fungus cerebri; with the more remote contingencies of cerebral softening and epilepsy. If paralysis appears early in the case, it usually indicates destruction of some cerebral nerves, or of that portion of the brain in which they originate. Unless it is due to pressure from a depressed portion of bone, it is in that case, usually permanent. If it comes on later, it is probably due to arrest of function,—as from clot or abcess, and the prospect of ultimate improvement is somewhat better. If an abcess forms, and can be located with sufficient precision, its contents should be evacuated. If the condition known as "fungus cerebri" appear, gentle compression, astringents locally applied, and excision of the protruding mass are to be resorted to.

As the formation of ascess is one of the frequent sequences of cerebral or meningeal inflammation, especially that resulting from traumatic causes, it is often as difficult as it is important, to decide upon its location when the fact of its *existence* has been determined. If it is known to be superficial;—if it lies immediately beneath the cranial bones or immediately beneath the dura mater — *i e*, if it has resulted from inflammation of the cranial bones, or of the

dura mater, or arachnoid, its evacuation can readily be accomplished by an application of the trephine. In such cases the seat of the original injury will often be an efficient guide in determining the location of the abcess. If it be located in the superficial substance of the brain, its situation may often be determined, and its evacuation effected in a similar manner. Of course the trocar or the aspirating needle will be required in addition.* It may be important to determine in advance of an operation whether an existing abscess is deep or superficial,—in other words, whether it is the result of cerebral or meningeal inflammation. There are no means presented by the *symptoms* resulting from these conditions, which have enabled us to distinguish inflammation of the brain from that of its enveloping membranes. It has been suggested by Dr. Agnew —and the correctness of his suggestion has been frequently confirmed by observation—that this matter might be determined by observing the comparative force in the temporal and carotid arteries. The temporal, occipital, frontal, and meningeal branches of the internal maxillary arteries have a free inosculation in the diploe of the cranial bones, making a free vascular communication between the arachnoid and dura mater and the cranial bones and scalp; while the brain and pia mater receive their blood supply from the internal carotid and vertebral arteries. It follows, therefore, that in meningeal inflammation, when the arachnoid, the dura mater and their exterior structures are alone inflamed, the temporal arteries will be observed to beat with peculiar force; when the pia mater and the brain are alone involved in the inflammatory process, the carotid arteries display a similar energy. When the brain and all its membranes are alike implicated, both sets of vessels are similarly affected.

The rupture of a vessel within the cranial walls often

*See note v.

gives rise to a dangerous compression of the brain, with resulting paralysis and coma. Its extent is frequently such that its location cannot be decided by the symptoms which it produces. Like other injuries of the brain, the resulting effects are observed on the opposite side of the body. This, with the marks of injury which may have been left by the blow which produced it, often give the only clew to its location. As the only relief for such an accident consists in the removal of the compressing clot, if it is superficial, and if its site can be determined with reasonable probability, the trephine should be applied and the clot removed. If symptoms of compression have been developed immediately after the reception of the injury, it is to be supposed that the point of hæmorrhage is where the middle meningeal artery enters the cranial cavity, or at the anterior inferior angle of the temporal bone. If the trephine be applied to this point, the compressing clot may sometimes be found and removed — if not, the meningeal artery may be tied and further hæmorrhage arrested. When failing to find the offending clot at this point, if the symptoms are sufficiently urgent, a similar exploration may be made along the course of the inferior meningeal artery. Extravasation in the cavity of the arachnoid has occasionally been relieved by a similar procedure. When it lies beneath the pia mater or in the deeper tissues of the brain, I am unacquainted with any efficient measures for its relief.

Penetrating and perforating wounds of the brain are usually made by missiles projected by firearms. These frequently carry into and lodge within the cerebral substance some foreign materials, like felt, hair, fragments of the cranial bones, etc. The missiles themselves may either lodge within the cranial cavity or make their exit by a second perforation of the skull. A very large proportion of these injuries are speedily fatal. A less number survive for a limited period; and a still smaller proportion either partially or completely recover.

If the wound be a perforating one it will usually be found that the missile has traversed a direct course through the brain between the points of its entrance and its exit in the cranial walls. It will ordinarily be easy and safe to explore its course through the encephalon, to discover and to remove any foreign or injurious materials that may have lodged along its course. The inner table of the skull will always be found more extensively fractured, at the point of entrance than the outer one; and more or less completely detached pieces of the inner table will usually be found impinging upon the membranes, perforating their walls or penetrating more or less deeply the cerebral tissues. These should, if practicable, be removed; and if the small size of the external opening interferes with the necessary procedures it should be enlarged by the trephine.* It seems needless to say that these measures should be conducted with the utmost delicacy and care and that the greatest caution should be observed in guarding against the possibility of inflicting any additional wound or injury of the brain or its membranes.

In penetrating wounds of the brain, when the missile has lodged within the cranial mass, the position of the attending surgeon is often a difficult and embarrassing one. The patient has survived the immediate effects of the injury, but a bullet or other projectile has penetrated the brain and lodged he knows not where. He is uncertain of the course it has taken — of how deeply it has penetrated, or what damage it has inflicted along the track which it has traversed; or what irritating or vulnerating materials it may have lodged along its course. He can do little towards rescuing his patient from his perilous condition until he has gained accurate information upon these doubtful points. But the procedures necessary to elicit this information may, unless carefully executed, be fraught

*See note vi.

with peril, both to his patient and to himself. If he makes no attempt to discover and to remove the missile, and death ensues, he is likely to be charged with negligence and want of skill, and made to suffer in reputation and in purse. If he explores the wounded brain, and seeks to discover and to remove the offending materials, his best conceived efforts in this direction may totally fail, and ensuing death be attributed to his most laudable efforts to avert it. The old travesty upon the doctrine of predestination—

> "You'll be damned if you do,
> You'll be damned if you don't,"

seems especially applicable to him; and if still more unfortunately the case which he has in hand should be one of attempted or accomplished homicide, he is liable to be assailed, and traduced as the party upon whom the guilt and penalty involved in the case should mainly rest, and he should make it certain that nothing in his procedures can verify such an accusation.

What course then, should a surgeon take when assuming the duties and the responsibilities pertaining to a case of penetrating wound of the brain?

In assuming charge of such a case, or of any other, the surgeon should ignore all considerations relating to himself, to his pecuniary interests or his reputation. His *duty to his patient* should be the sole consideration that determines his course. He has no right to adopt any measure, or to perform any operation, inspired by a desire for the *eclat* that its success may bring him; still less has he a right to abstain from any measure that in his judgment is necessary for the promotion of his patient's recovery, or that is best calculated to promote it, from any apprehension of censure that would attend its possible failure.

He should carefully observe the general condition of his patient, the location and appearance of the external

wound; obtain any information he can in regard to the nature, size and propelling force of the missile, and of the direction from which it came. This information may aid him greatly in determining his subsequent steps. If the missile has passed beyond the surface; if it is of large size and of such a nature that it must necessarily be a source of irritation and danger, a careful exploration of its track should be made. For this purpose the finger is the best instrument. If the missile or other foreign materials be found, their prompt removal should be effected.* If it has penetrated too deeply to be discovered in this manner, a blunt or bulbous probe, like that of Nelaton, may be passed carefully along the track made by the missile for the purpose of discovering its location. This should be done in the most careful manner possible;—for it is to be remembered that the texture of the brain is so destitute of connective tissue that an exceedingly slight degree of force may penetrate it in any direction. An ordinary probe should not be used for this purpose, or if used at all, absolutely no force should be applied to it after entering the brain. If its own weight will carry it along the course of the wound, it may, perhaps, be used in that manner with reasonable safety. It is likely to do no harm, and to give as little information. But a slight degree of force applied to its propulsion constitutes a new element of danger; for as Dr. Agnew says, no one can tell, when applying any force to an ordinary probe, under such circumstances, whether he is following the track of a missile, or whether he is burrowing a new channel through the brain. All recognized authorities condemn such a method of probing the brain, and an additional wound made by such a procedure may be more dangerous than the original injury, and constitutes not only a surgical blunder, but a surgical crime.† Unless the missile,—especially if it be a leaden

*See note vii. †See note xi.

ball,—can be readily found and easily extracted, it is usually safer to allow it to remain within the cranial cavity than to undertake its discovery and extraction by promiscuous probing and violent measures for its removal*. Exploration of the brain, if resorted to at all, should be done early. In consequence of the almost entire absence of contractile tissue in the brain, a bullet or other missile in penetrating it, leaves an open track along its course. If a small probe be introduced into such a wound, its own weight, if the position be favorable, will be sufficient to carry it forward as long as the wound remains unobstructed by clots. But when these form and have acquired firmness, they will offer about the same resistance as the normal brain structure, and then it must become difficult or impossible for the surgeon to know whether he is pushing his instrument along the course of a wound previously existing, or whether he is inflicting another and an equally dangerous one.

Does the probability of benefit to the patient, arising from an exploration of the brain, and a search for a missile which has lodged in its deeper structures, justify such a proceeding? If dangerous symptoms arise, and if the foreign body can be discovered in any portion of the brain, and its extraction accomplished by such measures as do not add to the original peril, their removal should usually be undertaken. But if they cannot be found without a promiscuous and guideless hunt through the brain, they had better be let alone. This organ occasionally shows a remarkable tolerance of foreign bodies, especially metallic substances, like lead and iron, which readily become encysted, and have remained for long periods of time comparatively harmless tenants of the brain, or giving but slight evidence of disturbance from their presence†. I would, therefore, in a doubtful case, prefer to give a patient

* See note viii.

†See note ix.

the benefit of the chances which this fact affords, rather than to subject him to the dangers which attend the infliction of an additional injury, with the remote and uncertain prospect of resulting benefit.

If the missile inflicting the wound be of small size and the external wound correspondingly small, and no dangerous symptoms are presented—unless the missile is located quite superficially—no attempt should be made to explore its course through the brain, or to attempt its removal. Such measures would probably be attended with more serious consequences than the original injury. I have seen patients recover from such a wound in the anterior and middle portions of the brain without ever exhibiting any symptoms that would indicate a serious injury.

Or if, on the other hand, the missile has evidently penetrated the deep and central portions of the brain and lodged among the ganglia at its base, there is little to be hoped for from any attempt to discover its exact location and to effect its removal. It is likely to be fatal sooner or later if it remains; but the probability of prolonging life by attempting its removal is so slight as scarcely to justify an effort in that direction.

If it has penetrated the upper or frontal portion of the brain, if the missile is of large size and is of a nature that must necessarily render it a permanent source of irritation; or if it has passed through, or nearly through the brain, and lodged at or near the surface, its removal should be attempted. In the latter case, a counter-opening through the skull will facilitate its extraction. Here, as in every wound of the brain, thorough drainage and the most scrupulous aseptic dressings should be rigidly adhered to through the entire course of treatment.

Experience has shown that there are few portions of the brain into which missiles have not found their way*

*See note x.

and lodged for considerable periods of time, without giving rise to any serious disturbance of the system. These, it is true, are exceptional cases—but we know that they may occur; and they do occur with such frequency that in doubtful cases it would seem more prudent to accept the slender chances that their possibility bestows, rather than to complicate, by surgical procedures, even a prospectively fatal injury with a view to the doubtful benefits that *may* arise from their performance.

Whether the wounding missile be removed from the brain or left within it, the subsequent treatment should be conducted upon the general principles already stated.

NOTES.

NOTE I.—Otis. Med. and Surg. Hist. War of Rebellion, pt. i, surg. b., pg. 65. Thirteen cases of deaths reported from concussion of brain.

NOTE II.—*Ibid*, pg 68. Fractures of *frontal* bones, resulted . . . 22 cases: 10 died, 6 discharged, 5 returned to duty. *Parietal*, 33 cases: 15 died, 12 discharged, 4 returned to duty, 2 unknown. *Temporal*, 7 cases: 6 died, 1 discharged. *Occipital.* All died. *Base of skull*, 11 cases. All died.

NOTE III.—J. A Liddell. Am. J. Med. Sciences, April, 1882. Sixty-three cases of fracture of inner table of skull without external fracture: Seven cases recovered, six of these were trephined—in one necrosis of external table occurred—56 ended fatally

NOTE IV.—Stromeyer claims to be able to correctly diagnose and to locate fractures of inner table of skull by percussing with a silver probe over the suspected section.

NOTE V.—Fenger. Am. J. Med. Sci., July, 1884. Aspirated abscess in frontal lobe 2½ inches from surface—entered needle in several directions before finding abscess—recovery.

NOTE VI.—Med & S. H. W. R , p't. i, pg. 276. Operation by Dr. Bliss—recovery.

NOTE VII.—*Ibid*—Pg. 196, et seq.

NOTE VIII.—*Ibid* 186 wounds of cranial cavity 101 fatal—85 cases of removal of missile with 43 recoveries. 101 cases in which projectile was not removed, 59 fatal and 42 more or less completely recovered.

NOTE IX.—Dr. H. D. Noyes. (Am. J. Med. Sciences, July, 1884,) removed breech pin of gun 4 7-16 inches long, ½ inch wide, from nose orbit and brain, in which it had remained five months without producing serious disturbance. *Ibid*, pg. 59. Dr. Daniel Burr reported case in which tube and nipple of gun were carried in

brain four months without disturbance of health. *Ibid*, Jan. 1885, pg. 128. Dr. G. W. H. Kemper relates case of breech pin of gun 1½ inches long removed from brain—recovery.

NOTE X.—Gross System of Surgery, vol. ii, pg. 160 et. seq.

NOTE XI.—"There can be no doubt that all extraneous substances within view or reach, in cases of penetrating wounds of the cranium, should be removed by the surgeon; but before he commences any unguided search for them in the fragile structure of the brain, he ought seriously to consider the injury which he may inflict. He should remember that patients have died under the surgeon's hands while exploring the brain to find foreign bodies; and furthermore, that life has been preserved in many instances where they have not been looked after, or their presence unsuspected. When the track of a leaden ball, or any other body is to be traced through the brain, an elastic bougie may well be employed for the purpose. In its absence a female catheter, or the porcelain-tipped probe of Nelaton may be employed. These instruments should be allowed to sink into the wound by their own weight; *they should not be pushed forcibly onward.* It is better to temporize than to probe, violently, an injured brain. Great care should be taken that the exploring instrument is not thrust out of the track of the foreign body. When the site of the missile cannot be found by one, or at most two explorations of the wound, further attempts to find it by probing should not be allowed."—*Holmes' System of Surgery, vol. i, p.* 657.

"The finger is, of course, the best probe, but all officious interference is to be avoided, inasmuch as it is far better to let the missile and even detached pieces of bone remain where they are, than to search for them at the risk of severe additional injury."—*Gross' System of Surgery, vol. ii, p.* 161.

"In cases of penetration, any exploration in search of the missile should be conducted with the utmost caution. It is impossible, after a probe has passed out of sight, to know whether it is following the track made by the ball, or whether it is penetrating the brain substance; and therefore, when the opening in the skull is sufficient to admit the finger, the latter should be used in preference to any other means of exploration. If fragments of bone, or any other foreign matter can be detached without needlessly pressing the examination, they should, by all means, be extracted; but unless they are quite accessible and easily located, all such attempts can only be productive of evil, and should be discouraged."—*Agnew's Surgery, vol. i, p.* 293.

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